ON THE THERMAL DIFFUSIVITIES OF DIFFERENT KINDS OF MARBLE.

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Last year we published in the Proceedings of the American Academy of Arts and Sciences an account of some determinations of the thermal conductivities of different kinds of marble, made by the so-called "Wall Method." The horizontal bases of a rectangular prism, of height small compared with the area of a horizontal cross section, were kept for a long time at constant temperatures, the final temperatures at two or more points in the vertical axis were determined, and the flux of heat through a definite central portion of the colder base was measured. For the details of the apparatus we refer to that paper.

In each experiment of one of our sets a rectangular prism 60 cm. square and not more than 6 cm. high was built up of a slab of the material to be tested, enclosed between two other slabs of the same material. Between each two consecutive slabs of the prism was placed a thin metal sheet. This consisted of two rectangular leaves of tinfoil, about 60 cm. long and a little less than 30 cm. wide, placed side by side, and separated by a narrow ribbon thermal element made by butt-jointing, end to end, with the help of silver solder, a strip of German silver, and a strip of copper of the same thickness as the tinfoil. After the edges of the ribbon had been varnished so as to prevent electrical contact, the ribbon and the tinfoil could be placed close together so as to form a continuous sheet of metal 60 cm. square and about 1–10 of a millimetre thick.

The ribbon thermal elements gave consistent results at all times, provided that the junctions themselves were in contact with the slabs between which they lay. If the tinfoil wings were considerably thicker than the junction-ribbon, or if the junction itself were scraped thin, the reading might be in error by an amount not easy to be accounted for by the mere resistance of the thin air-film on each side of the junction.

TABLE I.

	Sp. Gr.	Conductivity.	Avg. Sp. Heat (25° to 100°).	Sp. Heat per Unit Vol.	Diffusivity.
1. Carrara	2.72	0.00505	0.214	0.579	0.0087
2. Mexican Onyx . . .	2.71	0.00556	0.211	0.572	0.0094
3. Vermont Statuary . .	2.71	0.00578	0.210	0.569	0.0102
4. American White . . .	2.72	0.00596	0.214	0.582	0.0102
5. Egyptian	2.74	0.00623	0.212	0.581	0.0107
6. Sienna	2.68	0.00676	0.215	0.576	0.0117
7. Bardiglio	2.69	0.00680	0.218	0.586	0.0116
8. Vermont Cloudy White	2.75	0.00681	0.210	0.578	0.0118
9. Vermont Dove Colored	2.74	0.00684	0.208	0.570	0.0120
10. Lisbon	2.75	0.00685	0.211	0.580	0.0118
11. American Black . . .	2.68	0.00685	0.214	0.574	0.0119
12. Belgian	2.75	0.00755	0.206	0.567	0.0133
13. African Rose Ivory .	2.75	0.00756	0.212	0.583	0.0130
14. Tennessee Fossiliferous	2.71	0.00756	0.214	0.580	0.0130
15. Knoxville Pink . . .	2.73	0.00757	0.212	0.579	0.0131
16. St. Baume	2.70	0.00761	0.210	0.567	0.0134

After the absolute conductivity of a particular specimen has been carefully determined, between various pairs of temperature limits, the conductivity of any other specimens can be easily obtained by determining the temperature-gradient, in the final state, on the axis of a prism built up of the slab already tested, and the slab to be examined, with their attendant thermopiles and such other thin slabs as may be conveniently used. By varying the order of the slabs on different occasions, the temperatures at the faces of the slab to be examined can be altered, it being always understood that the thermal elements must be placed between slabs of approximately the same conductivities. The relative conductivities of different materials, if these conductivities are not widely different, can be determined with great accuracy by this method; and it is possible to

TABLE II.

	Higher Temperature.	Lower Temperature.	Average Specific Heat.	Calculated.
1.	80.2	26.90	0.199	0.1956
2.	80.2	26.91	0.199	0.1956
3.	75.7	26.00	0.196	0.1942
4.	76.0	26.10	0.199	0.1947
5.	63.0	24.40	0.196	0.1919
6.	61.0	24.36	0.185	0.1915
7.	61.0	24.30	0.191	0.1915
8.	53.0	24.60	0.181	0.1900
9.	53.0	24.60	0.193	0.1900
10.	48.1	22.27	0.189	0.1887
11.	48.0	22.24	0.189	0.1886
12.	44.3	22.40	0.188	0.1880
13.	44.1	22.20	0.188	0.1879
14.	44.1	22.40	0.189	0.1880
15.	91.5	27.90	0.197	0.1979
16.	100.00	29.66	0.199	0.1999
17.	100.00	28.20	0.191	0.1996
18.	100.00	28.10	0.198	0.1996
19.	100.00	28.38	0.200	0.1996
20.	79.1	25.54	0.196	0.1951
21.	79.1	25.80	0.193	0.1952
22.	79.2	26.40	0.198	0.1954

use much smaller slabs than are necessary for the determination of absolute conductivities.

For many purposes to which the results of our experiments might be applied, it is desirable that the specific heats of the various marbles should

be known; this information is given in the following table. For convenience the values of the conductivities, as printed on Page 56, Volume xxxiv. of the Proceedings of the American Academy, are appended. At least two specimens of each sort of marble except No. 15 were examined.

To determine the variation of the specific heat with the temperature, the following determinations were made by the "Method of Mixtures," upon specimens of Carrara marble dried at temperatures somewhat above 100° C.

These observations are well represented by assuming the following expression for the specific heat of dry Carrara marble: —

$$S = 0.1844 + 0.000379\ t^2$$

The fifth column of the above table gives the values of the mean specific heat between the given temperatures computed by the formula $Q = 0.1848\ (t - 25°) + .0001895\ (t - 25°)^2$ where Q is the quantity of heat in calories required to raise 1 gr. from 25° to the temperature t: this expression corresponds to the equation above given for S.

The 17th observation was marked for rejection, a piece of the substance having been dropped from the cup in which it was heated and hastily picked up and dropped into the calorimeter. As it is difficult to believe that this accident could cause so great a difference in the result as appears, we have thought it best to retain the observation.

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